

BULK SPECIFIC GRAVITY AND BULK DENSITY OF COMPACTED BITUMINOUS MIXTURES

(A Modification of AASHTO Designation T 166)

SCOPE

1. (a) This procedure covers the determination of bulk specific gravity and bulk density of specimens of compacted bituminous mixtures.

(b) This test procedure consists of two methods for determining bulk specific gravity and bulk density. These methods are referred to as "Method A" and "Method C (Rapid Test)".

NOTE: If it is desired to use "Method B", which is not included in this procedure, AASHTO T 166 shall be referred to. Method B should not be used with samples that contain open or interconnecting voids and/or absorb more than 2.0 percent water by volume. Method B is not acceptable for specimens that have more than six percent air voids.

(c) Method A should not be used with samples that contain open or interconnecting voids and/or absorb more than 2.0 percent water by volume as determined in paragraph 5(d). If the percent water absorbed by the specimen exceeds 2.0 percent, either Method C or AASHTO T 275 "Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens" shall be used.

(d) In the case of dispute when testing samples from an existing bituminous pavement, e.g. cores, "Method C" shall be used.

(e) This test method involves hazardous material, operations, and equipment. This test method does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

(f) See Appendix A1 of the Materials Testing Manual for information regarding the procedure to be used for rounding numbers to the required degree of accuracy.

TEST SPECIMENS

2. (a) Test specimens may be either laboratory molded specimens or samples from an existing bituminous pavement.

(b) Size of specimens - It is recommended that: (1) the diameter of cylindrically molded or cored specimens, or the length of the sides of sawed specimens, be at least four times the maximum size of the aggregate and, (2) the thickness of specimens be at least one and one half times the maximum size of the aggregate.

(c) Specimens shall be taken for bituminous pavements with a core drill, diamond or carborundum saw, or by other suitable means.

(d) Care shall be taken to avoid distortion, bending, or cracking of specimens during and after the removal from the pavement or mold. Specimens shall be stored in a safe, cool place.

(e) Test specimens shall be free from paper, tape, soil, and other foreign materials not intended to be tested as part of the specimen.

(f) If desired, specimens may be separated from other pavement layers by sawing or other suitable means. Care shall be exercised to ensure that specimens are not damaged during the separation process.

APPARATUS

3. Requirements for the frequency of equipment calibration and verification are found in Appendix A3 of the Materials Testing Manual. Apparatus for this test procedure shall consist of the following:

(a) Balance - A balance capable of measuring the maximum weight to be determined and conforming to the requirements of AASHTO M 231, except the readability and sensitivity of any balance utilized shall be at least 0.1 gram. The balance shall be equipped with a suitable suspension apparatus and holder to permit weighing the specimen while suspended from the center of the balance.

(b) Suspension Apparatus - The wire(s) suspending the holder shall be the smallest practical size to minimize any possible effects of a variable immersed length. The suspension apparatus shall be constructed to enable the container to be immersed to a depth sufficient to cover it and the test sample during weighing.

(c) Water bath - The water bath for immersing the specimen in water while suspended under the balance shall be equipped with an overflow outlet or a clearly marked "fill line" for maintaining a constant water level. The level of the water shall be adjusted before testing each specimen, if necessary, to maintain a constant water level.

(d) Oven - An oven capable of drying specimens at either 125 ± 5 °F (Method A) or 290 ± 10 °F (Method C).

METHOD A

PROCEDURE

4. (a) Dry the specimen to constant mass. Constant mass shall be defined as the mass at which further drying at 125 ± 5 °F does not alter the mass by more than 0.1 gram. Samples saturated with water shall initially be dried overnight at 125 ± 5 °F and then weighed at two-hour drying intervals. Recently molded laboratory samples, which have not been exposed to moisture, do not require drying.

(b) Cool the specimen to room temperature at 77 ± 9 °F and record the dry mass to the nearest 0.1 gram as "A".

(c) Immerse the specimen in water at 77 ± 2 °F for 4 ± 1 minutes and record the immersed mass to the nearest 0.1 gram as "C". Care shall be exercised to ensure that no trapped air bubbles exist under the specimen.

(d) Remove the specimen from the water, quickly damp dry the specimen surface by blotting with a damp towel, and as quickly as possible determine and record the surface-dry mass to the nearest 0.1 gram as "B". Any water that seeps from the specimen during the surface-dry weighing operation is considered as part of the specimen. The determination of the immersed mass and surface-dry mass of each specimen will be completed before the next specimen is submerged for its immersed mass determination.

NOTE: A terry cloth towel has been found to work well. Damp is considered to be when no water can be wrung from the towel.

NOTE: If desired, the sequence of testing operations may be changed to expedite the test results. For example, first the immersed mass, "C", can be taken, then the surface-dry mass, "B", and finally the dry mass, "A".

CALCULATION

5. (a) Calculate the bulk specific gravity of the specimen as follows:

$$\text{Bulk Specific Gravity} = \frac{A}{B - C}$$

Where: A = mass of dry specimen
B = mass of surface-dry specimen
C = mass of immersed specimen

(b) Calculate the bulk density of the specimen by multiplying the bulk specific gravity by 62.3 lbs/cu ft.

(c) For laboratory molded specimens of 1/2-inch or 3/4-inch bituminous mixes, the range of bulk density results for three replicate specimens shall not differ by more than 2.5 lbs/cu ft. For laboratory molded specimens of Base mixes, the range of bulk density results for three replicate specimens shall not differ by more than 3.0 lbs/cu ft. If this requirement is not met, the entire set of specimens shall be discarded and a new set of specimens shall be prepared and tested.

(d) Calculate the percent water absorbed by the specimen (on volume basis) as follows:

$$\text{Percent Water Absorption by Volume} = \frac{B - A}{B - C} \times 100$$

METHOD C (RAPID TEST)

PROCEDURE

6. (a) This procedure can be used for testing specimens which are not required to be saved and which contain a substantial amount of moisture. Specimens obtained by methods that introduce moisture, such as wet coring or sawing, can generally be tested the same day by this method.

(b) The testing procedure and calculations shall be the same as given for Method A, with the following exceptions:

1) The immersed mass "C" shall be determined first, then the surface-dry mass "B", and finally the dry mass "A".

2) The dry mass is determined as shown in paragraphs 6(c) and 6(d) below.

(c) Place the specimen in a large, flat-bottom drying pan of known weight. Place the pan and specimen in a 290 ± 10 °F oven. Leave the specimen in the oven until it can be easily separated to the point where particles of the fine aggregate portion are not larger than 1/4 inch. During separation of material, it shall be assured that no material is lost. Place the separated specimen in the 290 ± 10 °F oven and dry to constant mass. (Constant mass shall be determined as follows: Dry the sample for a minimum of 1 hour at 290 ± 10 °F. Record the weight of the sample to the nearest 0.1 gram. Continue drying and weighing until the weight does not change more than 0.1 gram at drying intervals of a minimum of 30 minutes.)

(d) Cool the pan and specimen to room temperature at 77 ± 9 °F. Weigh the pan and specimen, subtract the mass of the pan, and record the dry mass of the specimen to the nearest 0.1 gram as "A".

NOTE: For Method C, the drying of specimens to constant weight may be accomplished in a microwave oven, as described in Arizona Test Method 719.

REPORT

7. (a) The method that was used.
- (b) The bulk specific gravity to the nearest 0.001.
- (c) The bulk density to the nearest 0.1 lb/cu ft.
- (d) The absorption to the nearest 0.01 percent.